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DEVELOPING ELECTRONIC GOVERNANCE SERVICES WITH INTALIO|CREATE

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Abstract

The purpose of this thesis was to evaluate cloud-based software development platform called Intalio|Create by the request of Arcusys Oy. The aim was to determine which features are important in the development of electronic governance services, which techniques were used in their implementation in Intalio|Create and how well they worked. Conclusion about Intalio|Create's suitability for developing electronic governance services was made according to this data. During the thesis an implementation was made, that is, an electronic service that can be used to apply for municipal financial aid for the childcare payments.

This study is based on written sources and the Internet, as well as on experience gained during the implementation of municipal financial aid service for childcare payments. This implementation was used for determining the desired features for electronic governance services.

During the thesis the features that were deemed important are accessibility of the service, security and comprehensive user authentication, easy creation of electronic forms, comprehensive user documentation and good tools for databases, process management and integration. As result it was found that Intalio|Create is not yet mature enough for the development of electronic governance services because of the lack of good user documentation, tutorials and required features for creating electronic forms. With more development and time Intalio|Create can be considered a potential platform for developing electronic governance services.

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Keywords
Cloud services, software development, process management, electronic services

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Tekijä
Arttu Räty

Nimeke
Sähköisten asiakaspalvelujen kehitys Intalio|Createllä

Toimeksiantaja
Arcusys Oy

Tiivistelmä

Opinnäytetyön tarkoituksena oli tutkia Intalio|Create-nimistä pilvipalveluun perustuvaa ohjelmistokehitysalustaa Arcusys Oy:n pyynnöstä. Tutkimuksessa selvitettiin mitkä ominaisuudet ovat tärkeitä sähköisten asiointipalveluitten kehittämisessä, millä tekniikoilla niiden toteutus on suoritettu ja kuinka hyvin ne sopivat edellä mainittuun tehtävään. Näistä tiedoista tehtiin johtopäätös Intalio|Createn soveltavuudesta sähköisten asiakaspalvelujen kehittämiseen. Tutkimustyön ohessa kehitettiin päivähoidon tukirahapalvelu, jonka avulla voidaan hakea kunnallista tukirahaa lapsen päivähoitomaksuihin.

Tutkimus perustui kirjallisiin ja internetin lähteisiin sekä päivähoidon tukirahapalvelun kehittämisen aikana hankittuihin kokemuksiin ja tuntemuksiin, joiden avulla halutut ominaisuudet sähköiselle asiakaspalveluille määriteltiin.

Tutkimustyön aikana tärkeiksi ominaisuuksiksi valittiin palvelun saavutettavuus, järjestelmän turvallisuus ja kattava käyttäjien todennus, sähköisten lomakkeiden tekemisen helppous, kattava käyttäjädokumentaatio ja hyvät työkalut tietokantojen, prosessinhallinnan ja järjestelmäintegraation toteuttamiseen. Tutkimalla näitä ominaisuuksia todettiin, että Intalio|Create alusta ei ole vielä tarpeeksi kypsä sähköisten asiakaspalveluitten kehittämiseen kattavan käyttäjädokumentaation ja opasohjelmien puutteen takia. Lisäksi tarpeelliset ominaisuudet sähköisten lomakkeiden tekemiseen puuttuivat. Kehityksen ja ajan myötä Intalio|Create voi olla potentiaalinen alusta sähköisten asiakaspalveluiden kehittämiseen.

Kieli englanti	Sivuja 26 Liitteet 1

Asiasanat
Pilvipalvelut, ohjelmistokehitys, prosessinohjaus, sähköiset palvelut

Table of contents

Acronyms

IT	Information Technology, refers to anything related to computer technology, such as networking, hardware, software, the Internet or the people that work with these technologies.
NIST	National Institute of Standards and Technology, federal technology agency in the USA.
ICT	Information and Communication Technologies, refers to technologies that provide access to information through telecommunications.
BPMS	Business Process Management System, software bundle for managing business processes.
BPM	Business Process Management, systematic approach for making organizations workflow more effective
BPMN	Business Process Model and Notation, graphical presentation for specifying business processes in a business process model.
SaaS	Software as a Service, term related to cloud computing where you sell your software as a service
PaaS	Platform as a Service, term related to cloud computing where you sell your platform as a service
IaaS	Infrastructure as a Service, term related to cloud computing where you sell your infrastructure as a service
HTML	Hypertext Markup Language, markup language used for creating web pages.
JS	JavaScript, computer programming language used in web environments.
CSS	Cascading Style Sheets, a style sheet language for styling web pages.
OAuth	Open authentication, an open standard for authorization.
ANSI	American National Standards Institute, an American organization that creates standards for the computer industry
SQL	Structured Query Language, a query language used for accessing and modifying information in database.
NoSQL	Not Only SQL, a query language like SQL that is useful for large sets of distributed data
REST	Representational State Transfer, a set of principles defining how protocols such as HTTP and URI should be used when creating Web APIs.

API	Application Programming Interface, a protocol used as an interface by different software components to communicate.
SMTP	Simple Mail Transfer Protocol, an internet standard for electronic mail transmissions over IP networks
IP,	Internet Protocol
SOAP	Simple Object Access Protocol, a protocol specification for exchanging structured information in the implementation of web services.
HTTP	Hypertext Transfer Protocol, the underlying protocol used by World Wide Web.
URI	Uniform Resource Identifier, a string of characters used to identify a name or a web resource.
XML	Extensible Markup Language, a way to create common information formats and share both the form and data on World Wide Web, intranets and elsewhere.
JSON	JavaScript Object Notation, a lightweight data-interchange format.

1 Introduction

Arcusys Oy is an IT company established in 2003 specializing in open source services and solutions. Instead of offering the client only the traditional software Arcusys Oy provides services which include the software license and IT infrastructure for running the service.

Over the years Arcusys Oy has been using software called Intalio|BPMS, a business process management system developed by Intalio, Inc. According to Arcusys Intalio|BPMS is lacking some required features such as cloud computing and therefore they would like to know if it is possible to replace Intalio|BPMS with Intalio's new software development platform Intalio|Create. This thesis focuses on Intalio|Create as a platform for developing electronic governance services and solutions, in other words electronic services that handle requests that usually rely heavily on forms and requests which have been traditionally handled as manual paperwork. The service providers are usually municipal or governmental organizations.

Intalio|Create is a cloud-based software development platform which heavily emphasizes designing instead of coding. It aims to provide full set of tools for developing business applications in one simple package. To find out Intalio|Create's suitability for developing electronic governance solutions the required features for developing such applications must first be identified. By identifying these features we can see how they have been implemented in the Intalio|Create, what techniques were used and how suitable they are for this purpose.

The thesis has an implementation part which was done to demonstrate the Intalio|Create's suitability for developing electronic governance services. The subject of the implementation is a web service for applying for municipal child daycare aid.

2 Intalio|Create and electronic governance

2.1 Intalio|Create

Intalio|Create is a cloud ready software development platform. It aims to offer an environment where designing, developing and deploying applications is fast as well as easy. As a cloud based platform it can be deployed in either private or public cloud allowing access to the platform from anywhere. The ideology behind the Create is to emphasize designing instead of coding, minimizing the amount of coding needed. This is realized by the set of tools offered by the Intalio platform. [1.]

Traditionally developing software requires a vast amount of different development tools varying from database applications to rapid application development platforms. These tools are not always compatible with each other resulting in additional complexity. Intalio|Create aims to remove this complexity by offering all the tools needed in one simple package and therefore eliminating additional complexity resulting from multiple application stacks and systems. [1.]

One of the toolsets included is Intalio BPM, where BPM stands for business process management. This tool allows creation and management of business processes inside Intalio platform. By combining business process management and other traditional development tools in a cloud ready platform Intalio|Create takes a quite unique approach to the application development.

2.2 Architecture of Intalio platform

The Intalio Platform is made of collection of services organized in two layers built upon each other: foundation services and platform services. The foundation services are the basic building blocks of the Intalio platform and include items such as data stores, runtimes and data access and access control services. Foundation services are quite similar to the kernel of the operating system. [2, Intalio Platform]

The platform services are the components that allow the development of applications on top of the Intalio Platform and they were built by using the foundation services. These include services such as system interfaces, user interface and integration services. [2, Intalio Platform]

Intalio|Create is delivered as a packaged Virtual Machine. The operating system installed on this virtual machine is Ubuntu Server. In virtualization basic concept is to programmatically divide a single physical hardware to run multiple operating systems and applications. This enables better usage of the hardware resulting in cost savings over time. The programs which are used for virtualization can be referred to as hypervisors. In short programs that can be used to create and manage Virtual Machines and their resources.

Intalio|Create supports following hypervisors: [3.]

- Virtual Box
- VMware Fusion (PC)
- VMware Player
- VMware ESX

2.3 Cloud computing

The history of cloud computing goes all way back to the 1960s. At the time the average user did not have his personal computer but instead the computing power was centralized in the huge mainframes that could be accessed from the terminals. This is the ideology behind cloud computing - accessing the computing power from remote locations. It was not until the development of the IT infrastructure in the 1990s that made it possible to utilize cloud computing as it is utilized today. [11, p. 6-7; p. 17-18.] Today by the NIST definition cloud computing is

> Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. [4, p. 6]

Cloud computing uses three different service models:

- **Software as a Service (SaaS):** The user is provided access to applications running a cloud infrastructure. These applications are accessed through thin client interfaces such as browsers. The user has no access to underlying cloud infrastructure or the platform where application runs. [4, p. 6]
- **Platform as a service (PaaS):** The user is provided a computing platform where applications created or acquired using the tools supported by the provider can be deployed to the underlying cloud platform. The user has no access to underlying cloud infrastructure but has a control over applications deployed on the platform. [4, p. 6]
- **Infrastructure as a service (IaaS):** The user can manage the processing, storage, networks and other computing resources. Then user has no access to underlying cloud infrastructure but has a control over operating systems, storage and deployed applications. [4, p. 6]

Cloud computing has both its benefits and disadvantages. Cloud computing is cost efficient since no hardware acquirements and maintaining is needed. Backup and recovery is easy since it is usually handled by the service provider. Access to the information is easy since it can be accessed from anywhere. [15.]

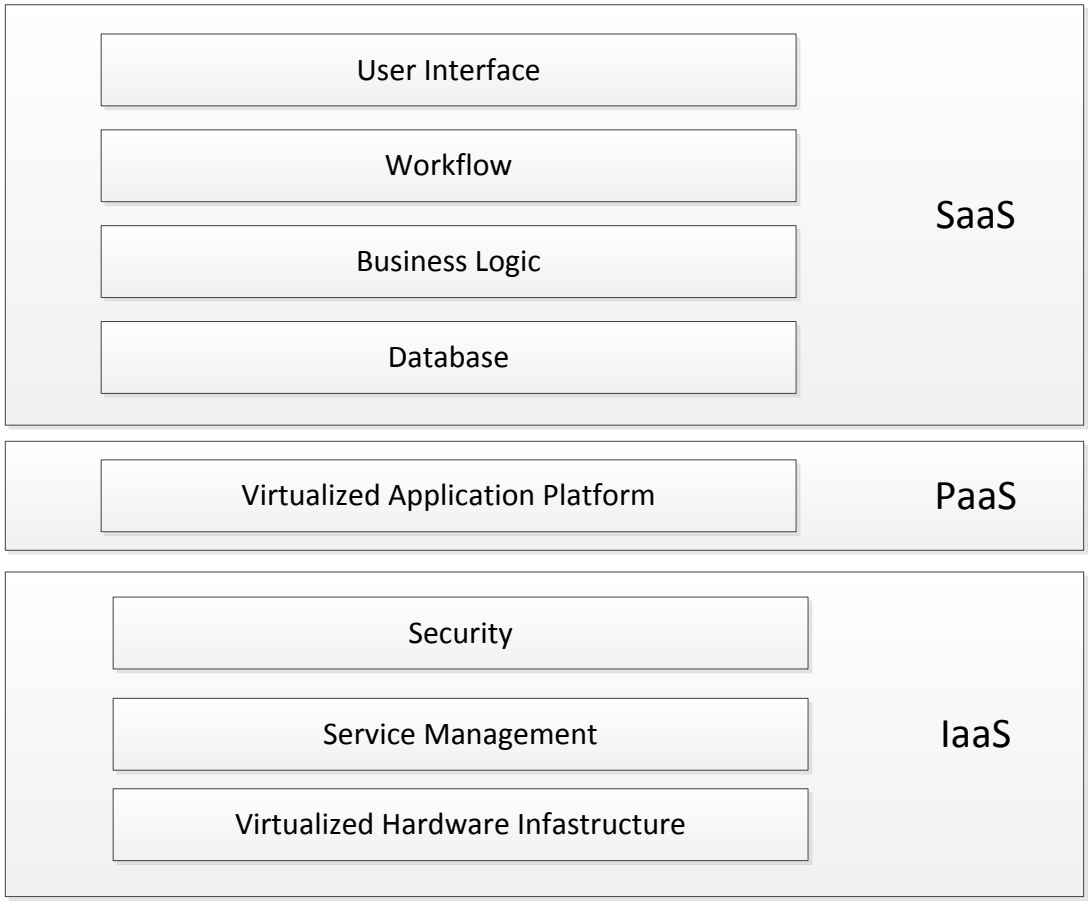
The disadvantages of cloud computing are mostly security and technical accessibility issues. Problems such as network issues could block your access from the system. Since the system is accessible from anywhere a lost password or successful hacking attempt may cause serious damage. Also the fact that your information is stored on third party provider must be taken to account. [15.]

Intalio|Create is based on the Cloud Foundry. Cloud foundry is an open PaaS which provides a choice of clouds, developer frameworks and application services for building applications [5.]. This makes it possible to deploy Intalio|Create on the cloud of your choice. Intalio|Create supports the following clouds: [3.]

- Amazon EC2
- HP Cloud
- VMware vSphere
- HPCloud

One of the key concepts in cloud computing is multi-tenancy. Multi-tenancy comes from the words multiple tenants. A tenant in this case is any application that requires its own computing environment. When multiple of these tenants are running on the same virtualized hardware the environment can be called multitenant.

Multi-tenancy applies to all three layers of cloud computing: IaaS, PaaS and SaaS. Highest degree of multi-tenancy allows the sharing of database schema and customization of business logic, workflow and user-interface. This degree is achieved by fully multitenant SaaS layer. In the medium degree of multi-tenancy each group of users have a different database schema and applications. In this case SaaS layer is partially multitenant. In the lowest level of multi-tenancy only the IaaS and PaaS layers are multitenant and every tenant must have independent SaaS layer. [19.]



Picture 1. Multi-tenancy on different cloud computing layers

There is no official statement from Intalio about Intalio|Create's multi-tenancy but in theory it should be possible to achieve highest degree of multi-tenancy with database

access control. By dividing the different tenants in user groups with different permissions the required data isolation of multitenant application could be. This would allow the running of multiple applications on the same Intalio|Create instance.

2.4 Business process management

Business Process Management (BPM) is all about processes. By definition business processes are series of value-adding activities within organization performed by certain actors to achieve a common goal or purpose. BPM aims to enhance these business processes according the wants and needs of the client and understand them better through the use of models. These models make it easier to identify and solve problems within the processes. Solving these problems promotes effectiveness, efficiency, innovation and flexibility. [13, p.1-2]

One important aspect of BPM is the system that allows execution of the business processed and their models. They are often referred as Business Process Management Systems or Suites (BPMS) suites. Currently there are various systems on the market Intalio|Create being one of them. They allow defining of processes in computer language, therefore making it possible to split processes in to multiple tasks and events, with different purposes and actors, and ultimately carrying out these processes.

BPMN is one of the languages used to graphically represent and define business processes. BPMN stands for Business Process Model and Notation. It is a standard maintained by Object Management Group (OMG) and therefore it is not owned by single vendor or consultancy. This makes it an open standard and completely free. BPMN is a diagramming language used to describe processes which is widely used by modelers and tool vendors. As a modeling language BPMN is precise enough to control process execution in process automation engine in other words Business Process Management System. [14, s. 3][16.]

2.5 Electronic governance

In the history of governance services the interaction between citizens and the government has taken place in the government office. Nowadays the development of the ICT infrastructure and the fact that 86 percent of the Finnish population has access to the Internet has made it possible to make these services electronic [12.]. Therefore electronic governance is about providing better public services to the citizens and organizations by the means of Information and Communication Technologies [6.]. This is achieved by making the public services available through the Internet. The providers of these services are for example municipal or governmental organizations.

There are many benefits for electronic governance. It simplifies the processes and therefore allows automation of services. The services are easily accessible as both citizens and officials handling these services can access them from anywhere. Correctly implemented electronic services can be efficient as well as affordable. [7.]

3 Objectives of the thesis

The objective of the thesis is to evaluate Intalio|Create as a software development platform for developing electronic governance services. The approach to this study is following. Everything begins with finding out the features that are deemed essential when developing electronic governance services. These features were gathered during the implementation period of this thesis basing on features that I found crucial or lacking during the development process. These features are presented in Chapter 5.

After identifying the desired features comes the task of discovering how these features have been implemented or have they been implemented. What techniques have been used? How mature are these features and what could be done differently? How do these features fit in to Intalio|Create's design ideology? The purpose is to answer these questions.

4 Implementation

4.1 What is this implementation about?

As the purpose of the thesis was to evaluate Intalio|Create as a development platform for electronic governance services this implementation is about developing such system. The implementation contributed to identification of desired features which are presented in the Chapter 4. The subject of the implementation is a service for municipal child daycare aid. The case proceeds as follows: The parents of a child want to apply for municipal aid for child daycare. They go to website providing the service, fill in the form, including the chosen child daycare center, for this particular service and send it to the service provider through the Internet. On the receiving end this form is processed and the decision about the amount of municipal aid is made. This decision is then forwarded back to both the parents and the chosen daycare center by email.

4.2 The form for child daycare aid

Parents are required to fill out a form. The form requires the following information:

- Information about daycare. Includes the starting date, type and chosen center for daycare.
- Personal data of the applying child. Includes first name, surname and social security number
- Personal data of all guardians. Includes first name surname and social security number.
- Contact information of all the guardians. Includes phone number, email and home address.
- Employment and income information for all the guardians and the child. Includes type of employment, salary and other sources of income.

This form was made with Intalio CMS. Intalio CMS does not have any graphical tool and therefore everything was written manually with HTML5 and JavaScript. The form is dynamic, that is, some information on the form can be hidden and made visible dur-

ing the filling process. Also some calculations about the estimated value of the aid are made. Some of the fields are required and their inputs are validated. The form also takes advantage of external web services used to retrieve information about child daycare centers and their prices. These have been emulated with Intalio|Create. When the submit button is pressed the form is posted to the server using Intalio|Create's REST API. More information about REST can be found on Section 5.5.

4.3 The processing of the form

From the form a new instance of the resume object is created, which contains the information of the form. Upon creation of this object an event is triggered starting a new instance of the resume process instance. The identifier of resume object is linked to the resume process so that this particular instance has access to information that was submitted in the form. The process is handled by the Intalio BPM application.

Next step in the workflow is the task of validating the arriving request. This task is appointed to the users that have a specific role for validating requests assigned for them. One of these users validates the request information manually and then either accepts or declines the request. Then parents and the chosen daycare center are informed of the decision by email. The sending of the email is done with SMTP, which stands for Simple Mail Transfer Protocol. After the sending of emails the process reaches its end state and the case is finished.

5 Desired features for developing electronic governance services

5.1 Accessibility

Accessibility refers here to the applications ability to be available to as many people as possible. The whole point of electronic services is to make them more accessible for the focus group of people. This makes accessibility a definite choice as a desired feature for Electronic Governance services.

One of the important features promoting accessibility is the fact that Intalio|Create is a web application. The benefit of web applications is that they share a similar, usually platform independent runtime environment, the browser. This allows reaching a large number of users from various operating systems [8, p. 8-10]. With user interface, based on HTML5, JS and CSS3 languages, Intalio|Create can be accessed with any major web browser through the public Internet. The users, developers and administrators do not need any additional programs to access its full functionality. Currently supported browsers are: Google Chrome, Microsoft Internet Explorer, Mozilla Firefox and Apple Safari. [3.]

The platform independent approach allows mobile device users to connect to Intalio|Create in similar fashion as from a desktop computer. Even though support for mobile platform is technically possible, Intalio|Create does not offer any native support for mobile platforms except for iPad tablets [3.]. For the end users however it is possible to create mobile portals and websites using Intalio's Content Management System, in short Intalio|CMS. Intalio|CMS is the main tool in Intalio platform for developing portals, portlets and other websites external to Intalio|Create system.

5.2 Security and authentication

In electronic governance services you are most often applying for some service using your identity, account or name. Therefore there must be means to identify if it is indeed you using the service instead of people claiming to be you. This is why electronic governance systems need a form of authentication. Usually applications require versatile user groups. Their permissions in the system vary according to their tasks and responsibilities in the system, making access control an important feature in electronic services.

Intalio|Create's authentication and access control is realized through Spring Frameworks Spring security and the protocol used for authentication is OAuth 2.0. The traditional way of logging in is using Intalio|Create's login page which prompts the user for username and password and then compares it to the username and hashed password

stored in the database. There is also a way to access Intalio|Create programmatically using OAuth 2 client library.

"The OAuth 2.0 authorization protocol enabled granting third party applications limited access to HTTP service on behalf of an end-user by orchestrating an approval between the end user and the HTTP service." [10.] Basically this means that instead of giving his username and password the resource holder creates an access token for accessing the wanted content and then passes that token to third party user which is then used in authentication.

The users, their roles and groups and the permissions these users, groups and roles have are managed through Intalio|Admin application. A user can be a part of multiple groups or roles. Roles have a set of permissions which define what functionalities a certain role has access to. The group and roles can have inheritance enabled allowing them to share their permissions to their descendant roles and groups. Pictures about the Intalio|Admin's user and permission views are presented in Appendix 1.

All permissions in Intalio|Create contain an operation that is allowed by the permission and an actor who receives the permission to use this operation. Let us take an example permission where operation is Create Object Record and the actor is user role called Clerk. This would allow all users with role Clerk assigned to them use operation Create Object Record, which would allow all users with Clerk role assigned to them to create new Objects to the Intalio|Create.

5.3 Database and object management

Most organizations today depend on databases for their business operations. Therefore it is no wonder that easy to use and efficient database services are core elements when building applications. Electronic governance services are no exception to this.

Intalio|Create is built of objects. The foundation and platform services discussed in the Section 2.2 are also objects. Objects present single data entities present in the system. These objects can contain varying information from primitive data types to other objects

called child objects in other words fields. Objects can be managed through Intalio|Crete's Object Designer application.

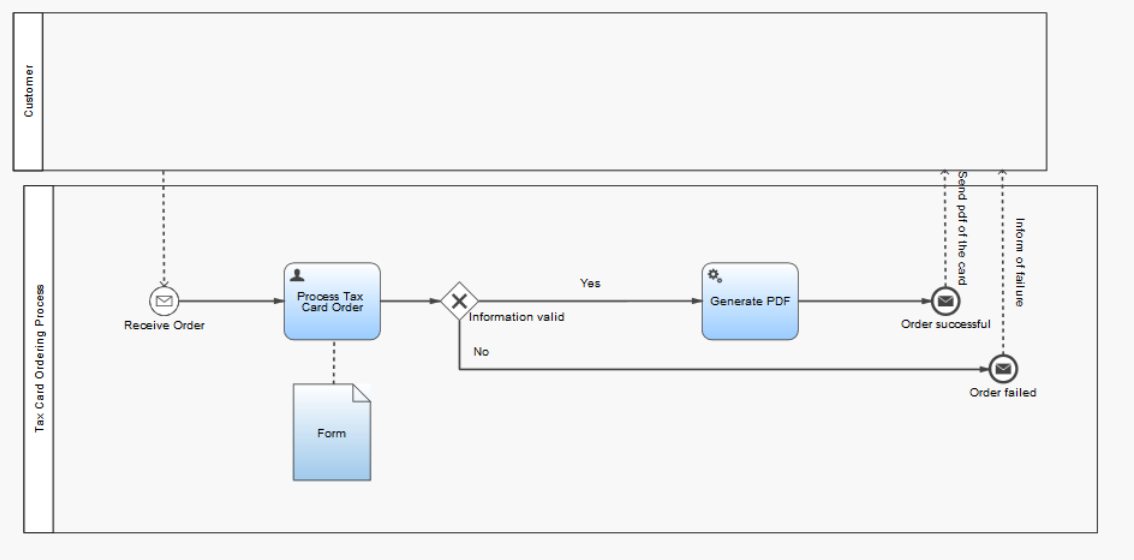
The platform handles the persistence of objects in the system automatically. New objects are stored in database once they have been created. Intalio|Create offers two database options PostgreSQL and MongoDB. The user can select which one to use upon creation of an object. If you create, update or delete objects the database must be synchronized afterwards. This updates the changes you have made to the appropriate database.

PostgreSQL is an open source object-relational database system which has a strong reputation. It is highly compatible with ANSI-SQL-2008 standard and is fully ACID compliant making it a reliable database management system. [9.]

MongoDB is an open source document-oriented database. Unlike the relational databases such as PosgreSQL the data is stored in documents instead of tables. A document is a set of key-value pairs which have dynamic schema. Thanks to this all items of the same collection do not need to have exactly same fields, for example empty fields can be omitted since they are useless. Unlike PostgreSQL MongoDB is based on NoSQL which is an alternative to SQL. [18.]

5.4 Process management

In electronic governance services processes serve as the backbone. Let us take an example of imaginary electronic service of ordering a tax deduction card. In the process the customer of the service would fill out an electronic form and then send it to the service provider through the Internet. Upon receiving this message the process for tax reduction card order would begin.



Picture 2. Tax deduction card ordering process

As illustrated in Picture 2 receiving the order, or in other words the filled out form, would start an instance of process called tax deduction card ordering process. The form received from the customer is attached to the Form variable of this instance. After the initial receiving of the order the workflow would move to a Process Tax Card Order task. This task is a user task which means it requires human input and is associated to certain actor. This actor then checks the information sent by the customer and makes the decision whether information is valid or not. If the information is valid the workflow would move to the next task called Generate PDF. This is a service task and it is automated. This task generates a document containing the tax deduction card of the customer. After finishing the task workflow moves forward to the Order Successful message end state. This end state sends the PDF generated in the last task to the customer. If the information was not valid at the Information valid gateway event the process would reach Order failed message end state and the customer would be notified of this failure. After reaching either one of the end states the process instance would end.

By splitting the process in the tasks it becomes easier to understand and can help the layman to understand the situation. Electronic services may also have multiple persons working on the same case on different phases. By using process management the process could be automated so that when the first person finished his task the next person working on the process would be notified and then he could continue. Or perhaps these tasks could be done in parallel fashion and when both of them are finished the process would move on. Business Process Management allows orchestration of such tasks.

Intalio is well known for its previous Intalio|BPMS, a Business Process Management System with a long history. Intalio|Create inherits this functionality. Intalio|Create supports BPMN 2.0 standard which is the latest implementation of BPMN.

In Intalio|Create processes are created through the graphical process designer. It is a drag and drop tool for creating business process models. The model elements can be configured as per BPMN 2.0 specification. The platform allows importing BPMN 2.0 models from other systems to Intalio|Create. Picture about the process designer can be found in Appendix 1.

5.5 Integration and web services

Electronic Governance services are most often composed of several smaller services that play a various roles in this particular service. For example there might be authentication services, information services and email services. The possibility to integrate previous systems and environments is also an important feature to have.

Intalio|Create offers a tool for integration and publishing web services. It is called Intalio Pipes which is based on Spring Integration extension of the Spring Framework. It is a graphical tool which allows modeling of services and integration interfaces. Picture about the Intalio|Pipes's user interface is presented in Appendix 1.

The platform itself comes with a REST API for every record. These can be used to create, read, update and delete records. The endpoints can be configured to require authentication.

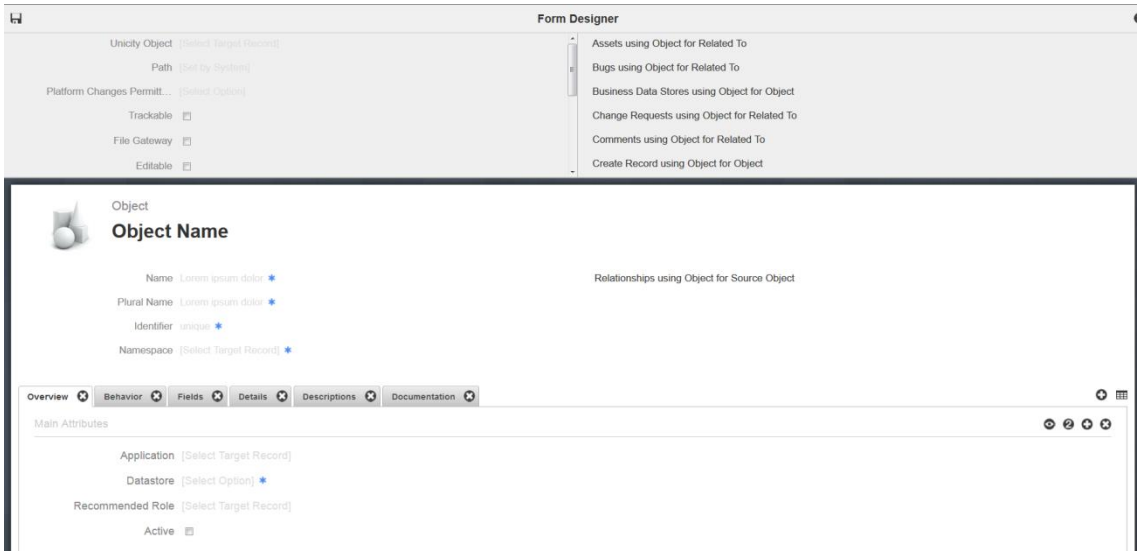
REST comes from words Representational State Transfer. It is an architectural style for designing web applications, which uses HTTP, a client-server communication protocol. One of the biggest implementations based on the REST architecture is the World Wide Web. REST is not a protocol itself but instead it tells how web standards such as HTTP and URIs are supposed to be used. URI stands for Unified Resource Identifier and it is a way to give a web resource a global identifier. In REST these resources are manipulat-

ed with operations called HTTP request methods between the client and the server. For example there are post, get and delete methods. These cover the basic create, read, update, and delete operations. For each request server returns a representation of the requested resource. These representations are usually HTML, XML or JSON documents. [17.][20.]

5.6 Electronic forms

Traditionally non-electronic governance services have relied heavily on large amounts of information delivered through physical forms. These forms are most often filled with pen and then processed by someone on the receiving end and then stored. Electronic governance eliminates physical forms and allows user to fill and send them using the computer. This does not change the fact that electronic governance services still depend on forms, meaning the creation and management of forms is important feature when developing electronic governance services.

Intalio|Create automatically generates form for all objects. These forms can be edited through Form Designer, a graphical tool for form editing. It allows adding and removing of fields, tabs and sections. These forms are always bound to a single object. This means you can not have fields from different objects on the same form. By filling out and submitting the form new instances of the selected object can be created.



Picture 3 Form Designer

Constraints for the fields in the form can be created with operation objects. These are custom lines of code related to certain object or none. Currently Intalio|Create supports Java Spring and Ruby computer languages.

Another way of creating forms is through Intalio's Content Management System. Intalio CMS can be used to publish portals, portlets and websites. This is possible by the use of Page object. This object allows creation of web pages. An example picture is presented in Appendix 1. Intalio CMS does not have any graphical tool but relies on manually written HTML5, JavaScript and CSS.

5.7 Comprehensive user documentation and tutorials

User documentation describes the features of the software. Intalio|Create provides many new tools for users' disposal so the documentation of is an important aspect for development. Comprehensive user documentation allows faster learning and prevents mistakes allowing more efficient development.

Currently the most comprehensive site for Intalio|Create tutorials is Intalio's educational site. [21.] The site offers some tutorials but it is still lacking. Another way to learn about Intalio|Create is through samples provided with the Intalio|Create instance. These samples provide a demonstration how certain features can be implemented using the Intalio's tools.

6 Conclusions

The accessibility of the Intalio|Create system is excellent as expected of cloud application. The browser based interface allows simple yet powerful way of getting your hands on the development tools without additional installation and configuration. The support for different browsers is comprehensive. The interface itself is simple and easy to understand and features of the system are easily found through the menu system. The

downside of this is the browser memory leaks which after the while make using the browser based interface bit sluggish.

The required security and authorization features are included. The OAuth 2.0 protocol allows the authentication and seems to work well. The Intalio|Admin allows user management and its permission system offers a way to create fine-grained permissions.

Databases work well and the choice of two different database types allows the user to make the system they want to. Intalio|Create handles the database connections and transactions and persistence automatically which allows the user to concentrate on more important matters and therefore saving time. Intalio|Create's Object Designer is supposed to offer an easy way to create new objects to the Intalio|Create system but in my opinion it still needs more development, since most of the time it would be faster to create these objects by hand and it would allow more customization. However in the hands of the non-programmer this tool can be quite efficient.

Business Processes in Intalio|Create work as per BPMN 2.0 specification. The graphical tool for creating and altering the processes is easy to use and contains the core elements of the BPMN. There is one problem though. There is a bug with the tool which makes adding new elements or saving impossible and therefore you lose all the unsaved changes you have done to the process. Also the documentation about the tool could be better.

With Intalio|Pipes, the tool for integration, it is easy to publish a web service that fetches data from database but more complex thing like building the integration interfaces are not. This is due the lack of tutorials for the Intalio|Pipes. In these tutorials only few of the basic elements are covered leaving a large number of elements unattended.

In governance services forms are an important element. Intalio|Create offers its Form Designer for creating forms but personally I would not want use these forms for the end-users since it is not easy to tie them to the backend. For example there could be a case where form is submitted through a portal that also handles the authentication, which would become complicated since this form would also be behind Intalio|Create's authentication. Forms created through Form Designer are not suitable for free forms

since they lack options that allow dynamic showing and hiding of fields and an easy way for creating field restrictions. Another way for creating forms is through Intalio|CMS. Unfortunately, the CMS lacks graphical tool for creation of forms so the forms have to be made manually using HTML, JavaScript and CSS. It allows high customization but doing everything manually is slow. In my opinion doing this manually like this goes against Intalio|Create's ideology that emphasizes designing instead of coding.

Currently the biggest flaw in Intalio|Create is the overall maturity of the system and the lack of tutorials and documentation for some of the features of Intalio|Create. For example I had some problems with Intalio|Pipes, the tool responsible for integration in Intalio|Create. In this case I created a SMTP service which sends email to the participants of the process, for reference I used sample provided by my Intalio instance. This sample had very poor notes about what certain elements do. This forced me to find out what these elements do through trial and error which is a very time consuming process. Intalio's education site, responsible for teaching how to use Intalio|Create, still has very little content. This might be because Intalio|Create is still quite new software and is under constant development.

This brings us to conclusion of this thesis, which in my opinion is that Intalio|Create is not yet suited enough for developing electronic governance services due the lack of the suitable tool for designing forms and the fact that Intalio|Create is lacking in documentation and tutorials. During the time of writing this thesis two new versions of Intalio|Create were released. This shows that Intalio|Create is still under constant development and perhaps with more time and development Intalio|Create can be considered a potential platform for developing electronic governance services.

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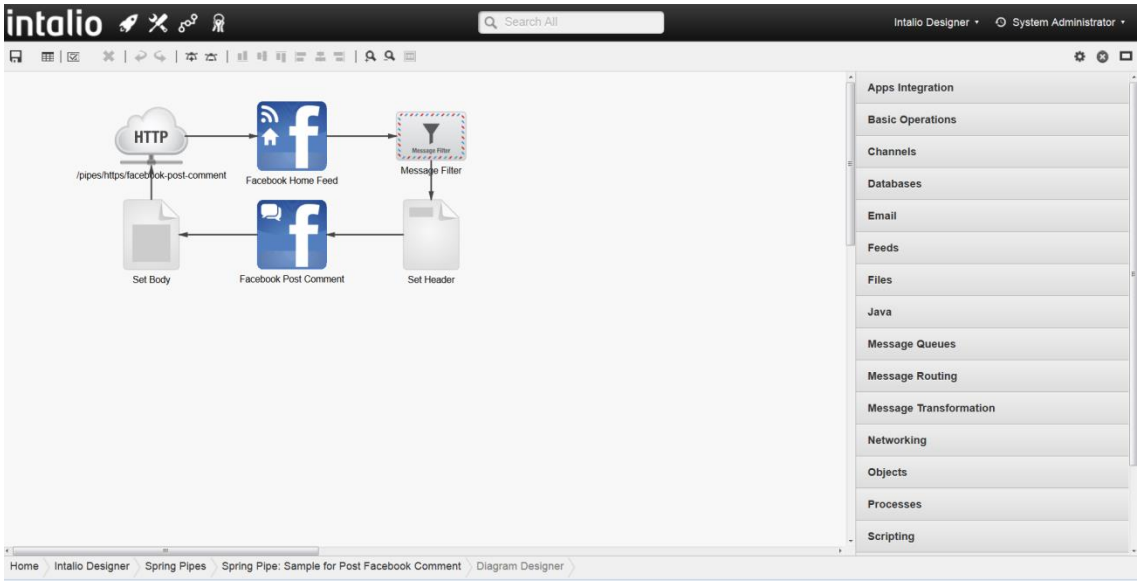
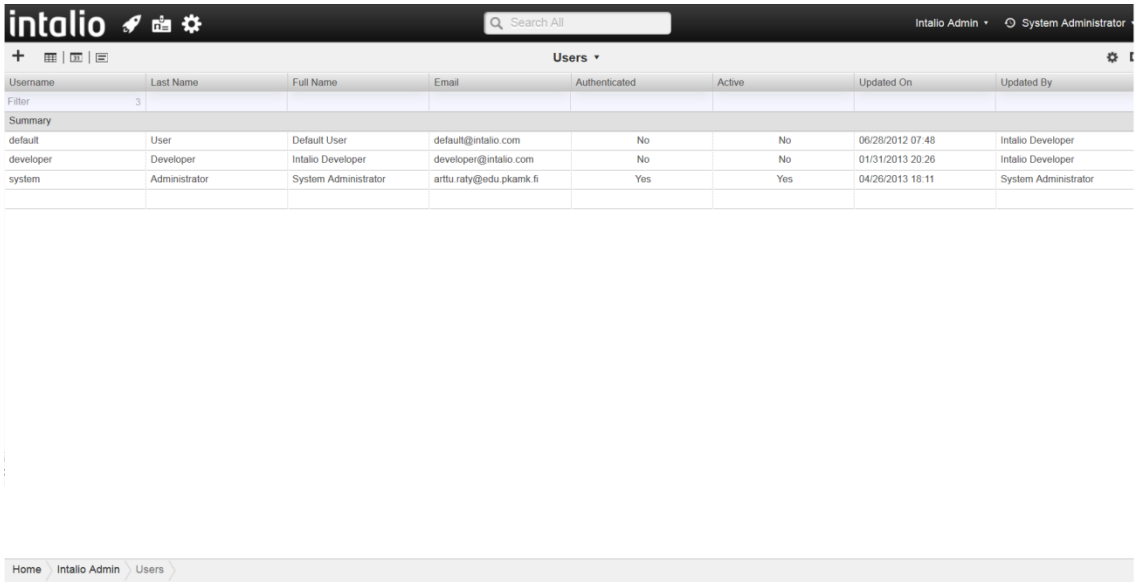
Pictures of Intalio|Create's user interface

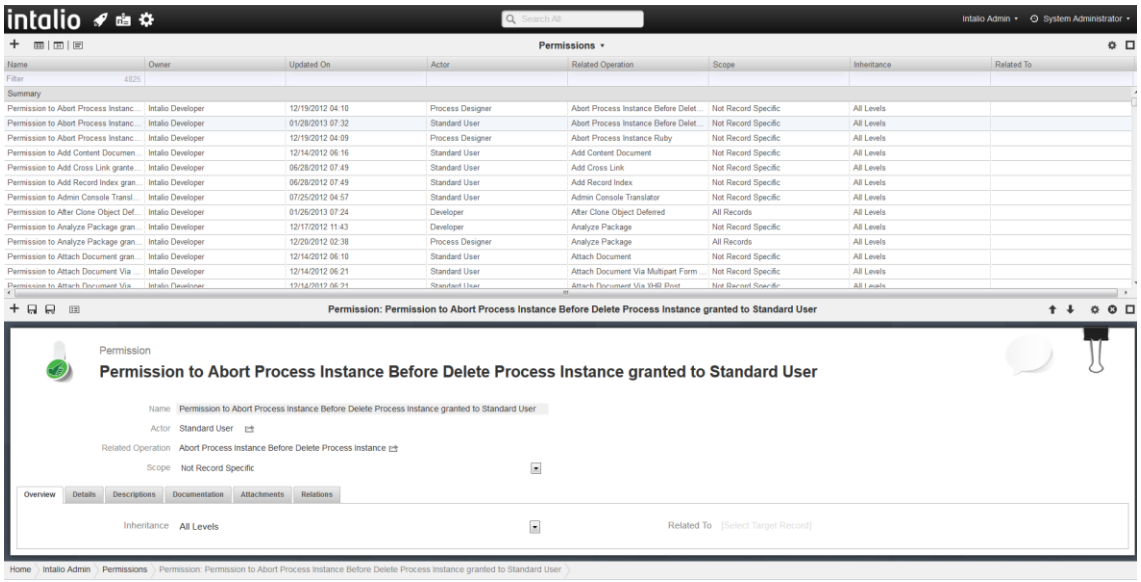
User interface of Intalio Pipes



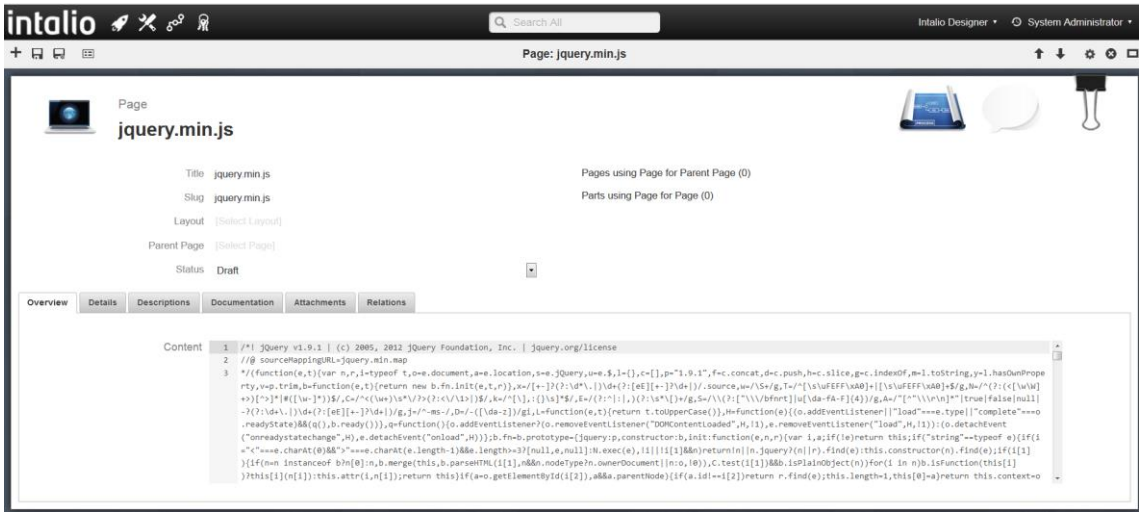
Users view from Intalio Admin



Permissions view in Intalio Admin



Example of Intalio CMS page object



User interface of Intalio BPM